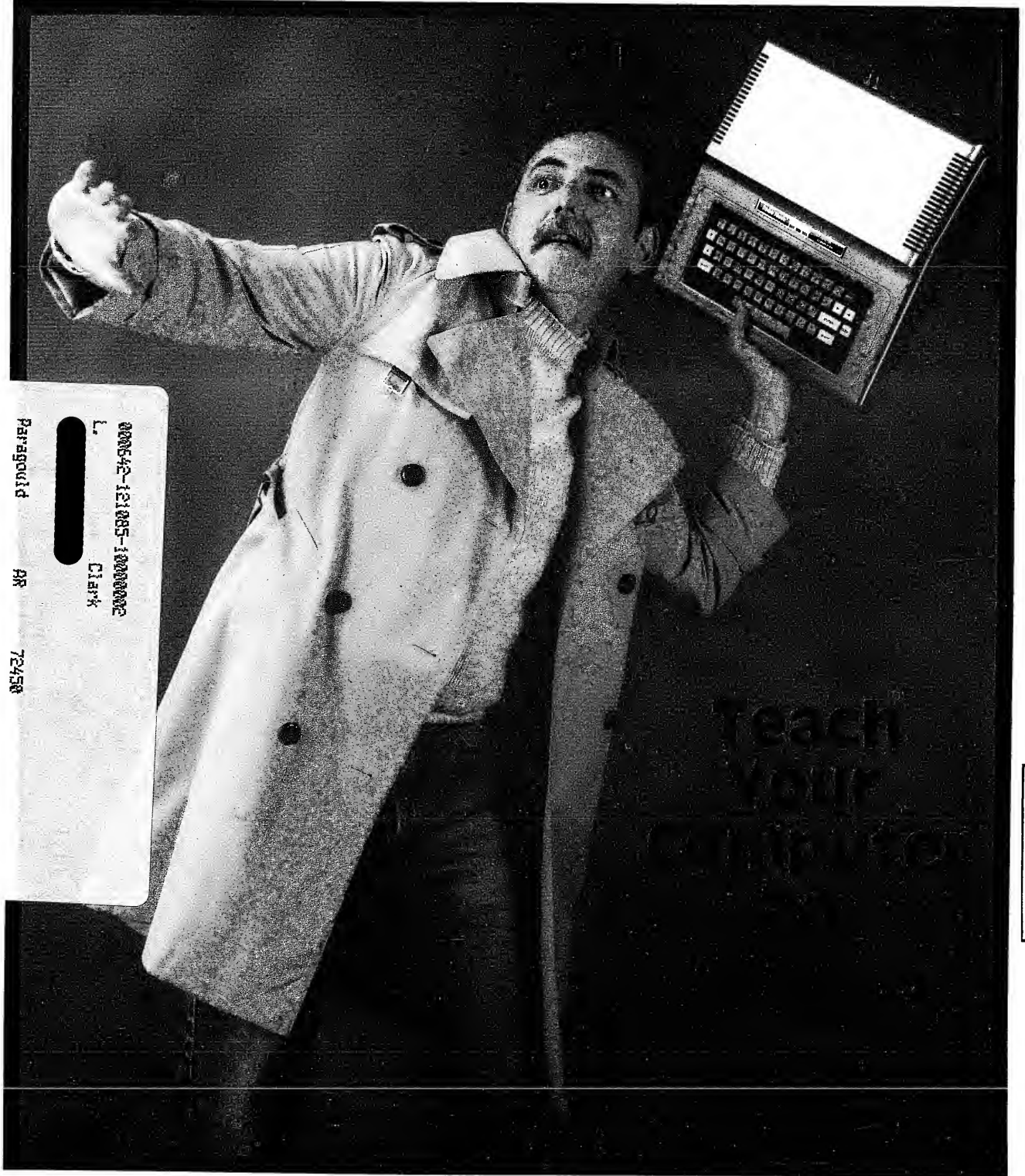


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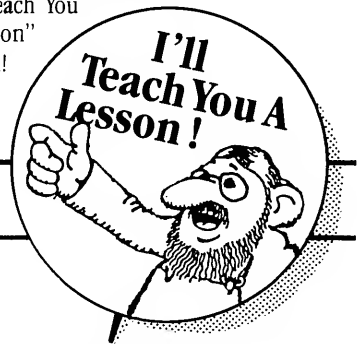
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Cover Photo by Charles Freiberg

I own a 16K Extended Basic Color Computer with an F board, which I recently upgraded to 32K.

Fifteen to twenty minutes after the computer is turned on, it will automatically print random characters on the screen and the program in memory is ruined.

When my Dad first got the computer, the problem wouldn't take place until a few hours after the computer was turned on, but the time has been steadily declining.

Recently we removed the RF shield, but that only prolonged the time for about half an hour.

The warranty on the computer has expired, and my Dad doesn't know any more about the problem than I do. Any suggestions?

*Michael A. Stuller
Rolla, MO*

Sounds familiar. The first thing I would check is the power supply. Some of these aren't soldered as well as they should be, and can sometimes cause the problem you mention. Get a soldering iron and, after unplugging the computer, resolder the parts on the power supply.

Next, if that doesn't cure the complaint, run the computer with the cover removed and wait for it to malfunction. Now carefully touch the top of each of the memory chips and the CPU and SAM chips. One of them should feel much hotter than the rest. That is probably the errant chip. Replacing it should cure the problem. Be careful: running the computer with the cover off is dangerous.

If you can't find a bad chip, you'll just have to take the computer into the repair shop.

I own a 64K Extended Basic computer and would like to add disk drives. Forty-track DS-DD drives seem to be best, but can their special controllers read RS-DOS disks? Do they have RS-DOS-like commands?

Also, could a PIA be mapped in the range of \$FF60-\$FFBF for communication with a parallel printer? What signals would the PIA have to supply and/or accept to work with a parallel printer?

*Jeff Allen
Bridgton, ME*

You have to contact the individual manufacturers to see if their DOSes can read RS-DOS disks. Some of them have special utilities that will do the job.

As long as you had a parallel device that was hard-wired to read the proper addresses, yes, you could drive a parallel printer. Just make sure the addresses you select aren't being used for another purpose. The voltages would all be TTL. In theory, the parallel device would monitor the printer PIA and wait until it saw data being sent to it. When the PIA is selected for output, the parallel device would scan the Color Computer data bus, read the data, and ship it out to the printer. Ideally, you would want to monitor the printer for ready/not ready status. The technical manual for a parallel printer will give you the pin-outs and uses for the various connections, and you can decide which you want to use.

The PIA's themselves wouldn't be used, since

they're strictly serial device units, and not designed to operate with parallel data.

When I use my four-foot flat cable with my disk drive interface everything works fine, but when I use the cable with the Multipak Interface, garbage comes on the screen and the keyboard crashes.

The computer is 23K EC with an HJL keyboard added.

*William H. Link
Richfield, NC*

The extension cable is the problem. The disk ROMpak uses fewer control signals from the computer and is less susceptible to interference from other sources. The Multipak Interface has its own power supply and must make all the control lines available to the various ROMpaks. As a result, interference is much more likely. The only cure is to make the connecting cable as short as possible, and to make sure it is a grounding plane cable (that is, that it is wrapped in metal foil that's grounded to both the computer and the Multipak Interface).

In the July 1984 issue of The Color Computer Magazine, on page 69 appeared the disassembler for the last four parts of ROM. I used my EDTASM to compare Extended Basic ROMs 1.0 and 1.1 (I have two computers here).

Comparing the four lines of source code from \$9178#\$9117 on both ROMs bore out Jake's contention that there was a bug in the ROM which has been corrected in the Extended Basic ROM 1.1.

The comparative listings are below:

<i>Ext. Color Basic 1.0</i>	<i>Ext. Color Basic 1.1</i>
9178/ SUBB #0A	9178/ SUBB #0C
917A/ BHS 9177	917A/ BHS 9177
917C/ ADDB #3A	917C/ ADDB #3C
917E/ STD, U++	917E/ STD, U++

As you can see, \$9178 has been changed from 12 to 10. However, running the listing below gave me identical results on both versions of ROM. Am I using EXP(X) the wrong way to yield different results on the different ROMs, or is the error using EXP above nine possible elsewhere?

The listing:

```
10 FOR X=7 TO 15 STEP .246
20 PRINT "EXP('";X;"') = ",EXP(X)
30 NEXT
```

The results were identical on both ROMs, with and without using Step.

*Dennis Anderson
Brooklyn, NY*

The bug is the Print Using command trying to display the proper exponent. In evaluating the exponent for the Print Using format, the original ROM subtracted 12 from the tens digit, instead of 10!

I have developed some programs that employ the RND operator, but have found it is not very random; in fact, it is quite predictable. The following simple program and its output will illustrate:

```
20 CLS
30 FOR N=1 TO 5
40 X = RND(8)
50 PRINT X
60 NEXT N
```

The output are repeated on runs as follows:

```
4 3 7 8
3 5 1 8
2 3 5 6
6 1 5 2
4 7 8 6
```

... which looks fine; however, when you shut off the computer and then power up and reload again, the output are exactly the same. Is there a programming technique which will give me truly random sequences?

*Richard M. Auclair
Westfield, MA*

Microsoft is the culprit. This RND problem is on most computers that use Microsoft Basic. The only true solution is to make your own RND machine code function and include it as part of your programs. That takes skill and requires a lot of work.

The easy kludge solution is to set up an INKEY\$ routine at the start of your Basic program that requires the operator to "Press Enter to Continue," with the INKEY\$ loop including `XX=RND(9)`. This is best done as part of the title page. Since the amount of time it takes the operator to respond by hitting the Enter key will be random (compared to the speed with which the loop will cycle), you'll get a random starting sequence each time. The only way for the operator to get the same sequence every time would be to hit the Enter key at the exact same instant every time the program starts. Given the computer's speed and the slowness of the human response time, you are almost guaranteed that will never happen, except as random chance.

I have a 32K Extended Basic Color Computer. I just recently purchased a number 0 disk drive. I am a novice, so I am not too familiar with all the terms used with the computers.

Please tell me how I may get a printed copy from the disk directory displayed on the TV screen. I would like to print it on my DMP-100 printer. I have called several Radio Shack stores and computer centers, but they do not know how to do it.

*Lloyd G. Lutey, Sr.
San Jose, CA*

That's an easy one—just type `POKE 111,254:DIR`. Your directory will be sent to the line printer.

I have a 16K Standard Basic Color Computer (grey). This year I plan to upgrade to 64K, get Extended Basic, and add a disk drive. Everything looked fine until Radio Shack discontinued the disk drive. What are my alternatives? I read that the new drive (white case) will not work with my model. Why? When I upgrade Basic will I get the new 1.2 version? (I have the latest model board before they put out the CC II.)

*Lewis Todd
Natchez, MS*

Don't worry, the new white case drive zero will work just fine with your old grey Color Computer. The confusion about which drives worked with which computers has finally been cleared. The grey case computer can use either the grey or white case disk drive zero. The white case computers can run only the white case disk drive zero. If you have the Multi-pak Expansion Unit, you can use either the grey or white case drive zeros with either of the color computers, grey or white.

If you buy a new computer, you'll get the new Basic 1.2. Otherwise you'll still have the old version ROM. The ROM version refers to the Standard Basic ROM, not the Extended Basic ROM.

Is there any way my C. Itoh printer will work with my Color Computer (original CoCo, upgraded 64K, Ext., revision board E)? I bought a C. Itoh Model 1550B Dot Matrix Serial Impact Printer. I purchased the printer without finding out how to connect it to my CoCo. I can't seem to get the proper hook-up or settings on the printer to enable it to run on my computer. It has serial interface, 25-pin connector (RS-232C), seven or eight bit capability. I am using Radio Shack's serial DIN plug to RS-232C cable end.

*Brent Prokopishin
Saskatoon, SK S7J 4G4, Canada*

The RS-232 cable sold by Radio Shack is designed only for use with modems, not with printers. You have to either re-wire the R/S cable or make one yourself. In most cases the set-up is easy. If you want to modify the R/S cable, get a pair of pliers and a screwdriver. Take apart the DB-25 connector. You'll see four wires exposed. One wire goes to Pin 1 of the DIN plus and to Pin 1 of the DB-25. Leave it alone. Take the wire from DIN Pin 2 and check its current position in the DB-25. If it isn't in position 20, use the pliers to pull the pin out of the DB connector and put it in position 20. DIN Pin 3 should go to DB Pin 7. DIN Pin 4 should go to DB Pin 3.

If you decide to make your own cable, just wire it the way I described above, and you're ready to go.

Now set the baud of the printer to 600, the word size to eight (seven if you have ROM version 1.0), no parity checking, and two stop bits. That should do the job. Good luck.

Hind Sight Hind Sight Hind Sight

By Bob Rosen

In September of 1980 Radio Shack introduced the 4K Color Computer for \$399. Computers that followed were the 16K Color Computer, 32K Color Computer, TDP-100, 64K Color Computer, Dragon 32, MC-10, Color Computer II and Dragon 64. What most Color users have never heard of is a machine that was going to be called the Deluxe Color Computer.

What is a Deluxe Color Computer? Good question! I will proceed to tell you about the Computer that wasn't. The Deluxe Color Computer was scheduled to hit the market before the 1984 Christmas season. The retail price was going to be \$399. It was going to include the following features: true lowercase; full screen editing; two RS-232 ports, the second port having an ACIA; 32K RAM Disk; keyboard with two additional function keys; 6-pin joystick inputs; sound chip; and color video output.

The true lowercase was going to be a vast improvement over the current reverse video mode now used for lowercase operation. The two RS-232 ports would have been a welcome addition for OS-9 users since the second serial port would have an ACIA chip in it. This would enable communications between two computers to operate up to 19,200 baud instead of the 300 baud limitation provided by the infamous bit-banging PIA chip. It should be also mentioned that the Deluxe's

ROM would have had a built-in terminal program. You notice that I said ROM, singular? The Deluxe was going to contain a single ROM that would have Standard, Extended and Disk Basic all in one! This would have caused some problems with existing software, especially from the third party market. After going through the new ROMs trauma for the past year, I certainly wasn't going to lose any sleep about missing out on this feature of the Deluxe!

When I heard the Deluxe was going to have 6-pin joystick inputs I immediately thought of Apple joysticks with two fire buttons. This would have created a new dimension for games. Even Marty Goodman's "Graphicom" would have benefited from two fire buttons on a single joystick.

Color video output is a feature I am going to miss. Nothing can match the vivid picture of a color monitor. Many a user has suffered from severe interference on their TV sets caused by disk drive cables, unshielded 300-ohm TV switch wire boxes and an assortment of hardware gizmos. Hooking a color monitor straight to the back of your computer would solve any interference problem. Fortunately, there are third party video drivers available. Still, having a video output on the back of the machine would have been nice . . .

Am I sorry the Deluxe was pulled off the market just before



its final stages? The answer is yes and no. The features I mentioned are definitely improvements over the present Color Computer II machine. But the two most important features that almost every owner would have wanted was more memory and a hi-res screen. The lack of memory expansion to 128K or more and a 80 by 24 screen would have taken some steam out of the initial enthusiasm for this new computer. OS-9 software, especially business applications, must have more than the 32 by 16 screen and 64K memory supported by Tandy.

The lack of these two features doesn't surprise me; present Color technology will not support them. The SAM chip must be redesigned or replaced for "true" 128K or 256K memory, and Motorola's new RMS and VDG chip set will not be available for initial supplies until the fall. Known as the "RMC chip set," it will have the following features: able to support up to 1 meg RAM, vertical resolution from 64 to 640 pixels, horizontal resolution from 64 to 500 pixels, 32 colors simultaneously out of a palette of 4096, smooth scrolling, lowercase, up to 60 character rows by 40 or 80 columns, underlined characters, inverse characters, blinking characters, double height characters, double width characters, different colored characters, and a 6883/6847 chip set emulation mode, too.

New rumors have evolved since the demise of the Deluxe that Tandy is moving up production of another machine. Already dubbed the "09" machine, it will be Tandy's answer to why they came out with OS-9 in the first place. As a follower of Radio Shack computers for the last seven years, all I can say is the only time to believe is when Radio Shack says it is so.

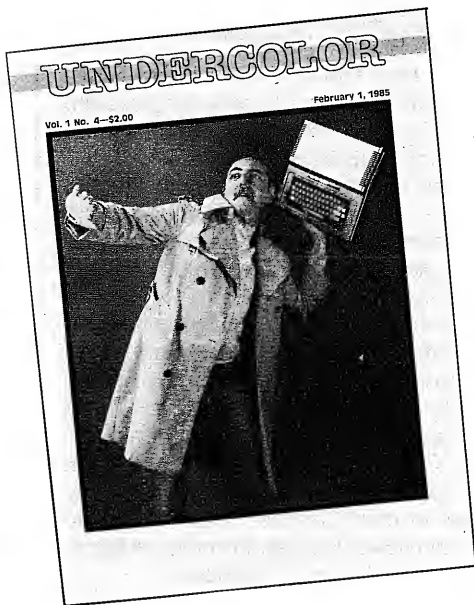
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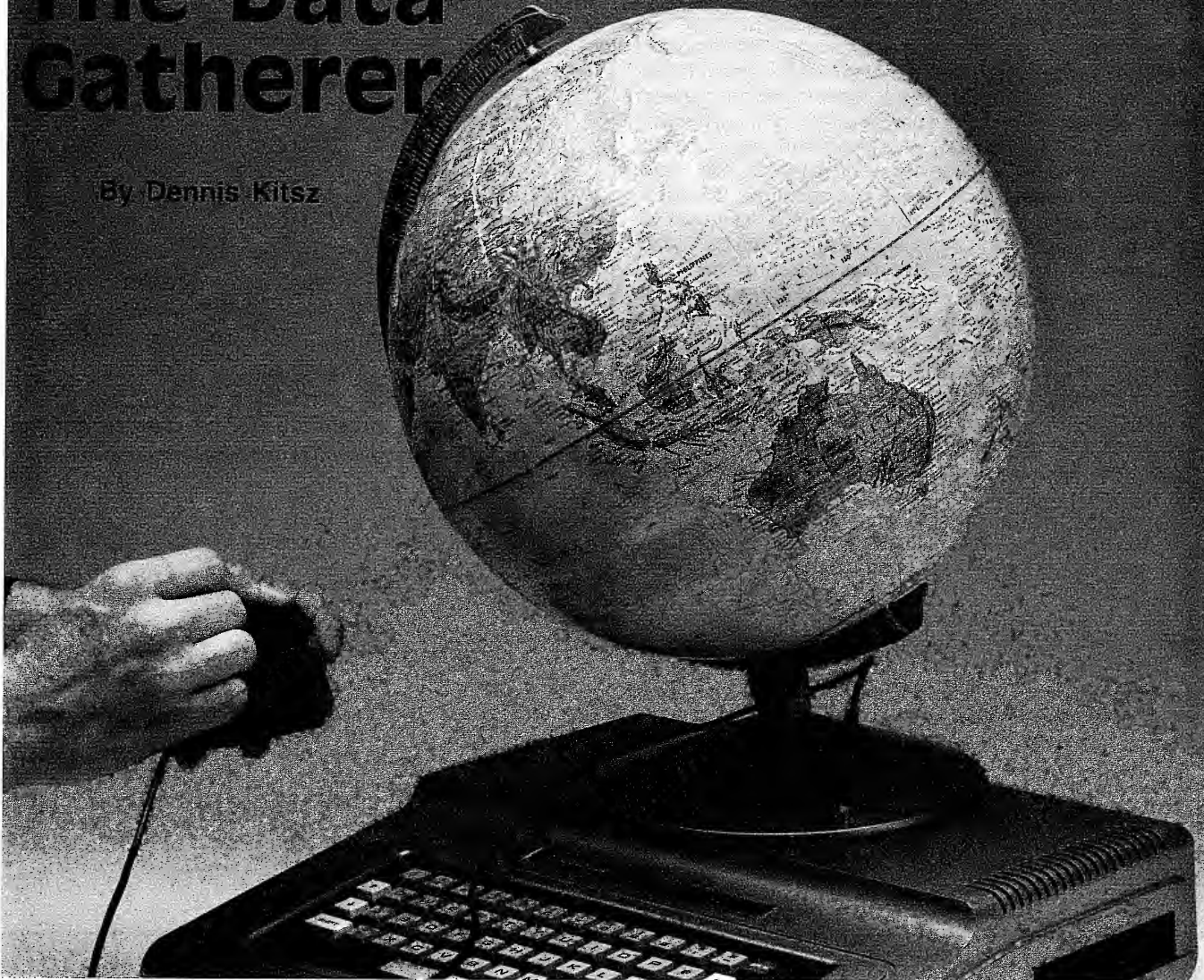
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The Data Gatherer

By Dennis Kitz



It's important for a data acquisition system to have read-outs . . . usually, a printed copy of the screen at specific intervals, or a continuous printed record of certain data. I have a bias in favor of parallel printers—the kind that accept an entire byte of data at once, print in both directions, and have memory buffers. The Color Computer was designed for a serial printer, which accepts only one bit at a time and, as a consequence, tends to print more slowly. Parallel printers for data acquisition can be very small and inexpensive (20-column thermal printers can be had for under \$50), whereas serial printers cost \$150 and up.

Those biases inclined me to design a standard Centronics-style parallel printer port as part of the system. Of course this parallel port can be used for any kind of digital input/output (including system expansion and the inclusion of megabyte-size "RAMdisks"). But, as designed here, it's a simple parallel printer port.

A modern parallel printer normally has an eight-bit output (for ASCII letters, numbers and symbols as well as graphics); it requires an electronic pulse (called a strobe) to indicate to the printer that a printable character has been sent; and it provides up to four "busy" signals so the software knows when to make the next printable character available. In the Data Gatherer, 8-bit data, strobe, and one busy are used.

The final feature of a data acquisition system is an operating system . . . not one that depends on a user to load a tape,

not even one that tries to load and run an environmentally sensitive file, but rather one that has the operating system stored in a stable read-only memory (ROM). The Data Gatherer has its own operating system (DGOS).

DGOS is stored in an erasable, programmable ROM (EPROM). Its subroutines include data input and output, channel selection, D/A conversion, A/D conversion, parallel printer control, clock read and set, and other routines. A special feature is the Basic download-and-run routine.

To use this feature, an 8K or 16K EPROM is programmed with DGOS. The remainder of the EPROM is programmed with the Basic program to be run. The rest is automatic; when the power is turned on, the Color Computer immediately sets up its Basic parameters and initializes the Data Gatherer software. Once initialized, DGOS downloads the Basic program and runs it. A user is needed for a tape system, and disk systems can't take heat or cold. But the DGOS download will survive heat, cold—and power failures. (A complete listing of DGOS will be presented later in this series.)

I mentioned that the Data Gatherer would be compatible with a full-blown Color Computer system, including disks. As it stands, though, the auto-boot from ROM is only provided for in a non-disk system. (For auto-boot from disk, refer to the ongoing eight-part series in *The Rainbow* by C. Stearman, which offers an outstanding group of "ROMmable" DOS patches.)

Aside from the auto-boot, DGOS will work with a disk system, although a little fancy footwork is necessary to get DGOS in place. Part of what takes place in a Color Computer system is the responsibility of the Synchronous Address Multiplexer (SAM). It takes care of blocking out the computer's memory into RAM, ROM#0 (Extended Basic), ROM#1 (Color Basic), ROM#2 (Disk Basic), and three small input/output (I/O) blocks. The SAM does this by providing three binary signals called S0, S1 and S2.

By hooking the SAM's S0, S1 and S2 to a 3-to-8 demultiplexer (an integrated circuit that turns three binary signals into eight distinct "select" lines), the memory map can be broken into the eight unique blocks described above.

The block for ROM#2 runs from memory location \$C000-\$FEFF (decimal 49152-65279). Look at the block diagram (last issue's Figure 1) again. At the bottom is a section marked "ROM logic." It turns out that Disk Basic is only an 8K ROM, and needs only addresses \$C000-\$DFFF (decimal 49152-57343). The rest is unused. It would seem reasonable to use the remaining addresses \$E000-\$FEFF (decimal 57344-65279) for extra user ROMs.

But that is not the case. Since (probably for economic reasons) Radio Shack chose not to add another integrated circuit to decode the disk ROM completely, it appears in identical form at both \$C000 and \$E000). The space from \$E000 on up is effectively wasted.

The ROM logic in the Data Gatherer breaks this memory area into two pieces, routing one to the Radio Shack DOS (\$C000-\$DFFF) and the other to DGOS (\$E000-\$FEFF). So the DGOS subroutines are available to all Color Computer users.

Using The Ports

The A/D and D/A converter system and printer port are accessed using 6821 peripheral interface adapters (PIAs). Because a PIA is a semi-intelligent circuit it can be difficult to understand. A microprocessor like the 6809 is supposed to be programmable, and its logic seems clear, but I've learned that many people (myself once included) are stymied by smart peripheral chips like the 6821.

Here's a precis. One purpose of a PIA is to read "outside world" digital data into the computer's central processing unit (the 6809 is the Color Computer's CPU). Its other purpose is to allow the CPU to send digital data to the outside world. The 6809 CPU reads and writes data in 8-bit words, or bytes.

The 6821 PIA has two 8-bit ports, that is, windows to the outside world. You can latch a byte into either port of the PIA, holding it there to control external devices, or you can input a byte through either port to read external devices.

What is especially useful about the 6821 PIA is that you can latch only *part* of a byte from the CPU (individual bits) at the port's output, and use the remaining bits as input to the CPU. Each binary digit of two bytes—16 bits in all— can be used differently . . . as a control line to the outside world, or for information retrieval from the outside world.

The tricky part is configuring the PIA, which means setting up which bits are input, which bits are output, and how the PIA is to respond to special conditions. Those special conditions include interrupts to the CPU and four special input/output lines.

The two eight-bit input/output ports of the PIA are arranged to appear at even-numbered addresses. For example, when a PIA is wired into the Data Gatherer, the input/output ports

for the A/D converter's PIA appear at addresses \$FF50 and \$FF32. In other words, if data is to be sent to the outside world, it is written to \$FF50 or \$FF52; data to be received from the outside world is read from \$FF50 or \$FF52. Configuring \$FF50 and \$FF52—choosing whether data in fact will be sent or received—is the job of the PIA's control registers.

The control registers of the PIA are arranged to appear at odd-numbered addresses. In the example of the Data Gatherer, the control registers for the first PIA appear at addresses \$FF51 and \$FF53. \$FF51 is the control register affecting port \$FF50; \$FF53 is the control register affecting port \$FF52.

In the control register, each bit has a separate meaning. Bits 7 and 6 provide information to the CPU about interrupts; bits 0 and 1 provide information to the PIA about interrupts. Bits 5, 4 and 3 control special "CA" outputs from the PIA. All these control bits can be used by the Data Gatherer, but are outside the scope of this article.

Bit 2 opens the door to your commands to the input/output ports. When bit 2 of control register \$FF51 is zero, you can tell the PIA which bits of port \$FF50 will be used as input, and which bits will be used as output. Here's the tricky part: *When bit 2 of control register \$FF51 is one, address \$FF50 actually is your input/output port. But when bit 2 of control register \$FF51 is zero, address \$FF50 merely identifies the direction of the port bits (in or out).*

Write 00000000 to control register \$FF51 (such as POKE &HFF51,0) and the PIA says, "I am ready for your command. Which way shall the data flow?" Then write the bits to port \$FF50 . . . 1 = out, 0 = in. Want them all outputs? POKE &HFF50,&HFF (binary 11111111). Want them all inputs? POKE &HFF50,0 (binary 00000000). Want upper half inputs and lower half outputs? POKE &HFF50,&H0F (binary 00001111). Want them alternating, half input, half output? POKE &HFF50,&HAA (binary 10101010).

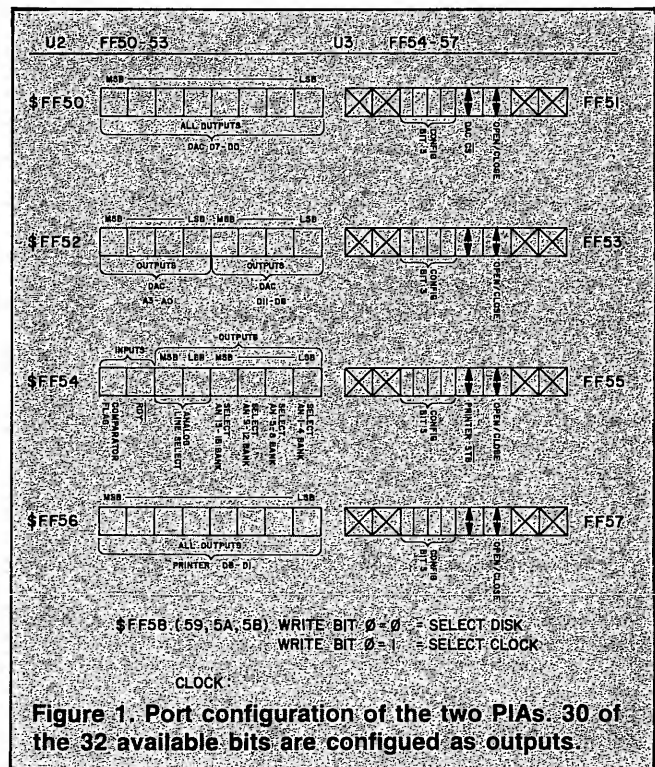


Figure 1. Port configuration of the two PIAs. 30 of the 32 available bits are configured as outputs.

Then, when you're done identifying the direction, make bit 2 of control register \$FF51 become high (0000100) with a command such as POKE &HFF51,4. The PIA says, "I have received your command and the data shall flow as you indicate." Address \$FF50 once again becomes the actual port through which data will flow.

The port configuration chart (Figure 1) summarizes this information for both PIAs—a total of four ports and their four complementary control registers. Note that ports \$FF50, \$FF52 and \$FF56 are all used as output in the Data Gatherer, but that port \$FF54 is split (two bits input, six bits output). Control registers \$FF51 and \$FF55 also have a unique use for bit 4, which I'll talk about in the circuit details.

Circuit Details

The complete schematic of the Data Gatherer is shown in Figure 2.

U1 is the demultiplexer that breaks down the SCS* block \$FF40-\$FF5F. \$FF40-4F is routed to the clock/disk bank-select circuitry. \$FF50-53 is routed to U2, the PIA which controls the digital-to-analog converter. \$FF54-57 goes to U3, the PIA which controls the parallel printer port and the analog switch circuitry. \$FF58-5B makes its way to the clock/disk bank-select flip-flop control, and \$FF5C-5F is a spare select line.

Parts of negative-logic AND gate U8 and inverter U11, plus flip-flop U7, form the clock/disk bank-select control. At power-up, the CPU's Reset* signal causes flip-flop U7 to make the Q output become 0 and Q* output become 1. When Q = 0 and Q* = 1 at power-up, the spare chip select \$FF40-4F is gated through U12b to form a disk select signal, Disk*. Therefore, the disk drive is available as soon as the system is turned on.

When Swap* (actually port \$FF58) occurs together with a write (WR*) from the CPU, the flip-flop latches the level on CPU data line D0. A zero on this line makes flip-flop Q = 0 and Q* = 1; conversely, a one on this line makes flip-flop Q = 1 and Q* = 0. When Q = 1 and Q* = 0, the spare chip select \$FF40-4F is gated through U12a to form a clock select signal, CLK*.

The clock/calendar is designed for 8080-style microcomputer signals, which means it expects separate low read (RD*) and low write (WR*). The Color Computer's 6809E has a single line (R/W*). To convert R/W* into separate RD* and WR*, R/W* is provided in normal and inverted (via U11) form, and gated with CLK* through U12c and U12d. The combination—at last—creates WRCLK* and RDCLK*.

The clock itself receives data lines D0-D3 and address lines A0-A3 from the CPU, plus a chip select (CS*, from CLK*). A 32768 Hz oscillator keeps it going, and a combina-

Some Custom Color Conventions

In the text of Custom Color articles, a star means active low, or logical NOT. For example, R/W* is "read / now write" or "read active high / write active low." In schematic diagrams, normally a bar is drawn above the signal name to indicate active low. However, this is difficult to typeset and often forgotten if done by hand. The star solves that problem.

Logical functions rather than electronic functions are shown in the schematics. For example, in Fig. 2, U8—a standard 74LS32 OR gate—is shown as an AND gate with inverted input and inverted output. This is a logical representation. In other words, this circuit is looking for LOW AND LOW and will output LOW when it finds that combination and no other. Here is the truth table:

Input A	Input B	Output Y
NOT 1 (0)	AND NOT 1 (0)	results in NOT 1 (0)
NOT 1 (0)	AND NOT 0 (1)	results in NOT 0 (1)
NOT 0 (1)	AND NOT 1 (0)	results in NOT 0 (1)
NOT 0 (1)	AND NOT 0 (1)	results in NOT 0 (1)

Now look at the truth table for an ordinary OR gate:

Input A	Input B	Output Y
0	OR 0	results in 0
0	OR 1	results in 1
1	OR 0	results in 1
1	OR 1	results in 1

Though the logical representation is different, the resulting electronic function is the same—a 74LS32, whether you call it an OR gate or a negative-logic AND gate.

Parts Source

Available from Green Mountain Micro, Bathory Road, Roxbury, Vermont 05669 (802-485-6112):

- **The Data Gatherer**, assembled and tested, with DGOS in a 2764 EPROM, plus documentation, \$330. Complete kit of parts, with DGOS in EPROM, plus documentation, \$220. DGOS only in a 2764 EPROM, \$35. Bare board only, \$35.
- documentation (complete manual, including data sheets for AD667 DAC, MM58274 clock and MC6821 PIA, \$15.
- Board, documentation and software, \$80.
- Board, documentation, software and hard-to-get parts, \$180.
- Hard-to-get parts available separately include AD667JN D/A converter (\$40); MM58274 real-time clock/calendar (\$15); 3.6 volt clock battery back-up pack (\$6); printer, disk, edge, male cable and transition connectors (\$6 each); 20-terminal strip (\$12); 18" shielded cable (\$10).
- The remaining parts are available from Green Mountain Micro or from Digi-Key Corporation, Thief River Falls, Minnesota. Call or write for Digi-Key's excellent catalog. Digi-Key has a toll-free order service at 800-DIGIKEY.

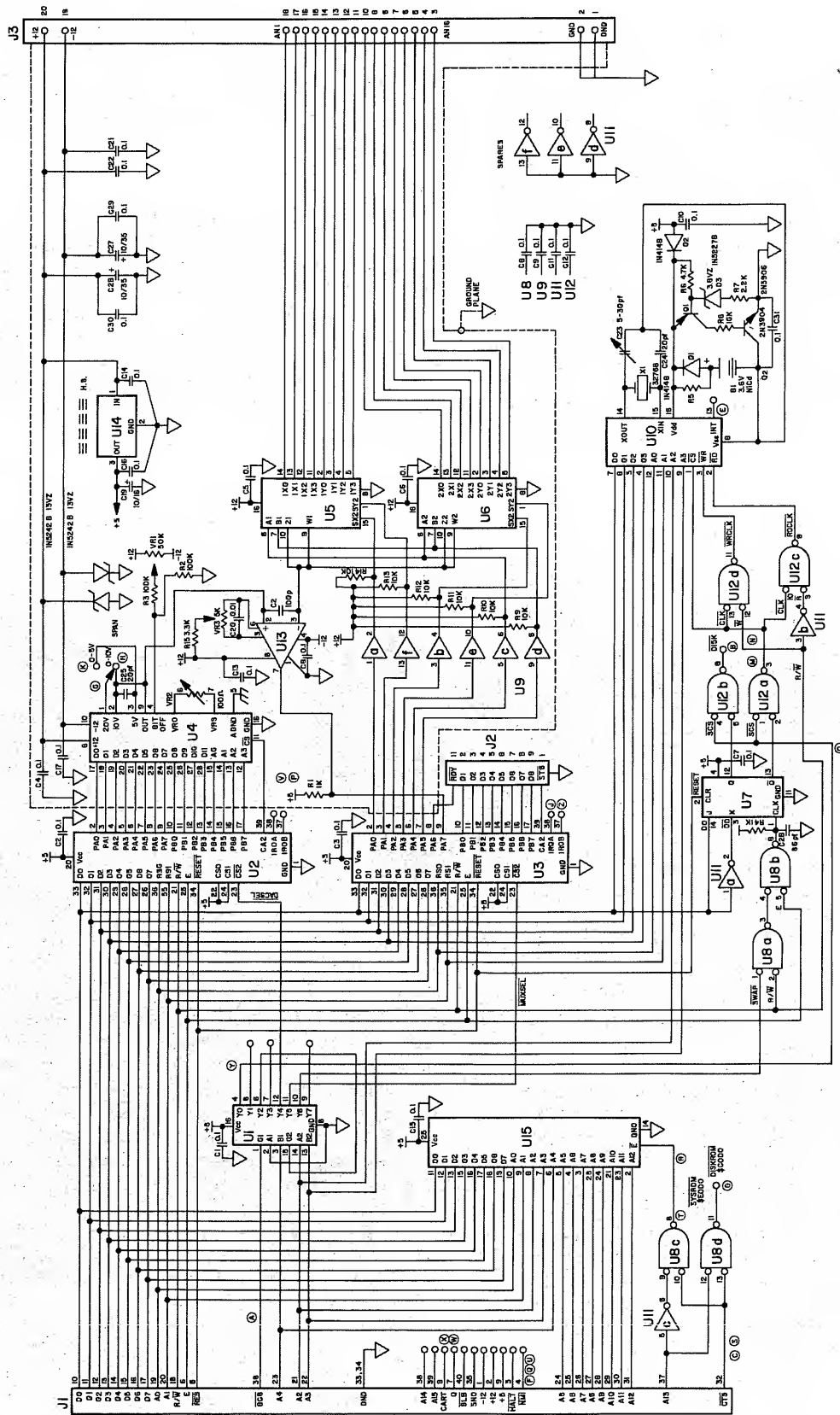


Figure 2. Complete schematic of the Data Gatherer reveals 15 integrated circuits and a host of small components for the sensitive analog circuitry.

tion of semiconductors provides the battery back-up and recharge.

U15 is the DGOS control of ROM. A combination of inverter U11 and negative-logic AND gate U8 filter the cartridge ROM select line (CTS*) into a high block (for DGOS) and a low block (for the Radio Shack DOS).

PIA U2 sends the 12 bits of data and four bits of address required by D/A converter U4. Note signal CA2, which is set up as an output (refer to Fig. 1) to strobe information into U4 via its chip select (CS*). U4 has a span select, a 0-volts adjustment, and a full-scale adjustment. Its output is fed to the non-inverting input of comparator U13.

PIA U3 sends eight bits of data to the parallel printer port. Signal CA2 is used as a printer strobe (STB*) (Fig. 1). Port A, bit 6, is used as a printer ready detect (RDY*), and port A, bit 7, is the output of comparator U13. These are the only two bits set up as inputs in the Data Gatherer system, although the parallel port can be reconfigured as needed for control if a printer is not used.

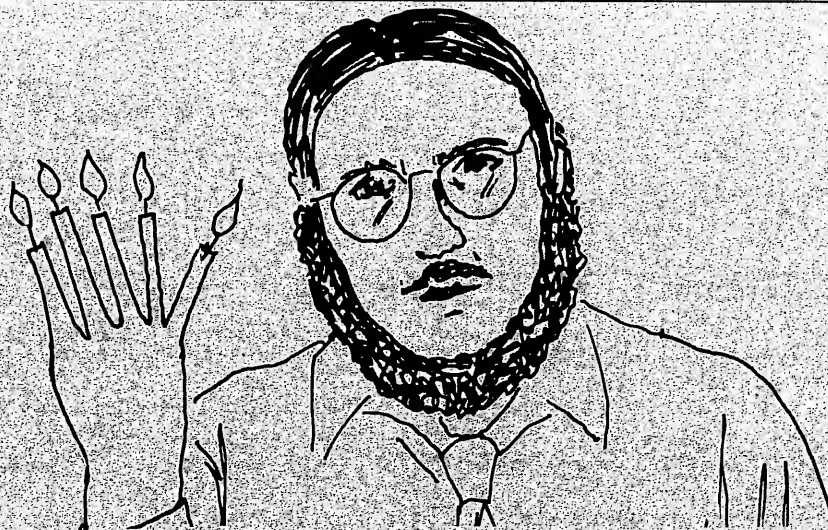
PIA U3 also controls the selection of one of 16 channels of input to the comparator. Open-collector driver U0 acts as

a level shifter for control of CMOS analog multiplexers U5 and U6. The combinations of A, B, SX and SY determine which input (from 1X0-1X3, 1Y0-1Y3, 2X0-2X3 or 2Y0-2Y3) is allowed to pass through the multiplexers (to Z1 or Z2), eventually feeding the inverting input of comparator U13.

U14, capacitors and zener diodes help stabilize and regulate the user-supplied power source of ± 12 volts, provide a logic supply of +5 volts, and protect the Data Gatherer from overvoltage.

Continued . . .

I'll give you a chance to collect some parts and get an idea of how the Data Gatherer and its components work. In the rest of this series, you will learn how to build the Data Gatherer, and what special information you need to know to keep it operating in a stable way (D/A converters can be terribly particular about how you wire them). I have test procedures for you, clock/calendar details, sample applications . . . and the full listing of the Data Gatherer operating system, DGOS. (end)



This is my fifth anniversary in the computer "business." In December of 1979 I officially traded in my amateur status, taking \$20 from *Byte* magazine for an obscure essay called "Relative Subroutines for the Z-80."

Now here I am with a publication called *Under Color*, five years wiser (I hope), but still believing that trust and good will have been the hallmarks of the personal computer field. Even the pirates and copy-protectors have been sincere. Trust made *Under Color* possible, a trust that (no matter how cynical my leanings) gives me a kind of hope.

Most of the computer friends I've made over the past few years have been unseen. I know your voices only through your letters, messages on CompuServe, or notes attached to subscription blanks. Occasionally we'll talk on the telephone. You are a most unusual and diverse group, linked only by a common thread of curiosity.

You trusted me to bring you *Under Color*, and I trusted you to support me. I couldn't do it alone, of course; some trusted friends helped, giving effort and energy without any compensation beyond my gratitude. We struggled against

time, since on August 17 we were tossed out of our last job.

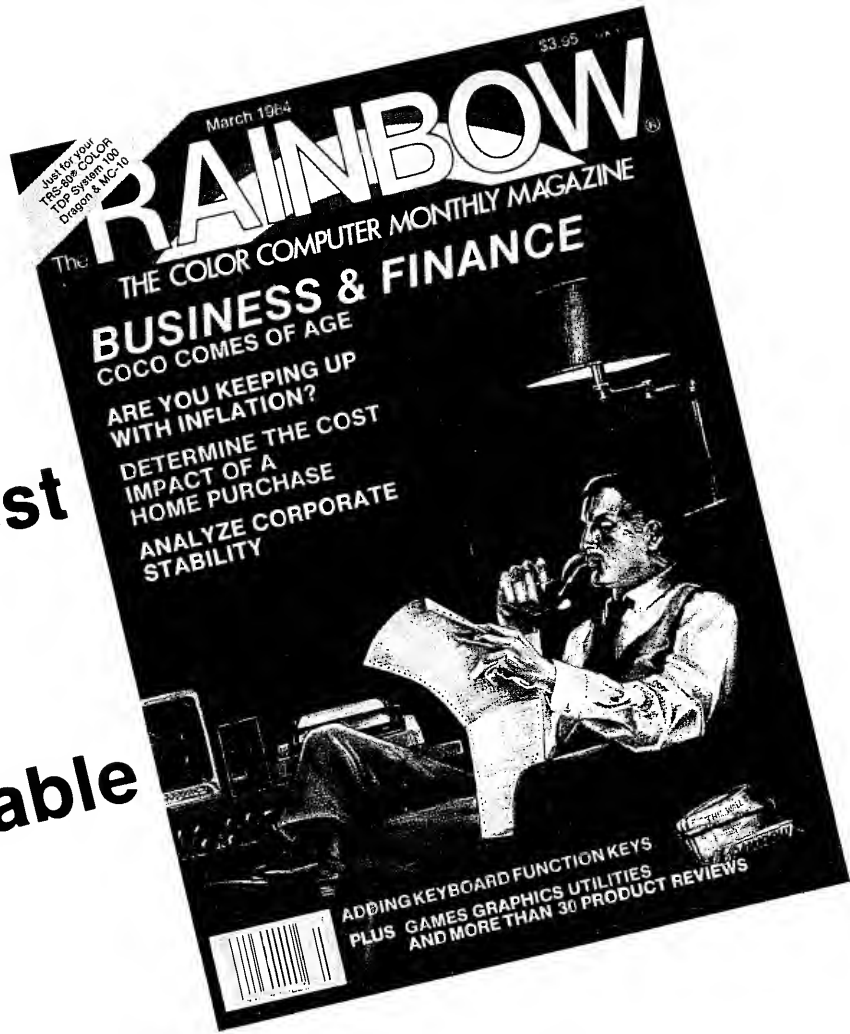
Yet—a month late and a few advertisements short—the first issue of *Under Color* was mailed. Subscribers—756—had been processed through our temporary, creaky, Model I-based subscription "system" in time to receive copies with computer labels. The rest were typed or handwritten.

With only our own funds and your subscription investment, we have begun an experiment in long-distance publishing: Deb Marshall edits from Maine, Clare McCarthy designs in New Hampshire, and I fret in Vermont. Our authors come from Minnesota and California and New York and Texas. I haven't seen Deb since September, nor Clare for two years. Yet *Under Color* is underway—through mail and telephone, but most of all, through trust.

They say the computer industry will undergo a shake-out this year, that everyone's running scared. Maybe I'm a fool, but your initial response to *Under Color* gives me confidence. As we enter the new year together—and gladly leave 1984 to philosophers—I wish you all the very best.

—D.B.K.—

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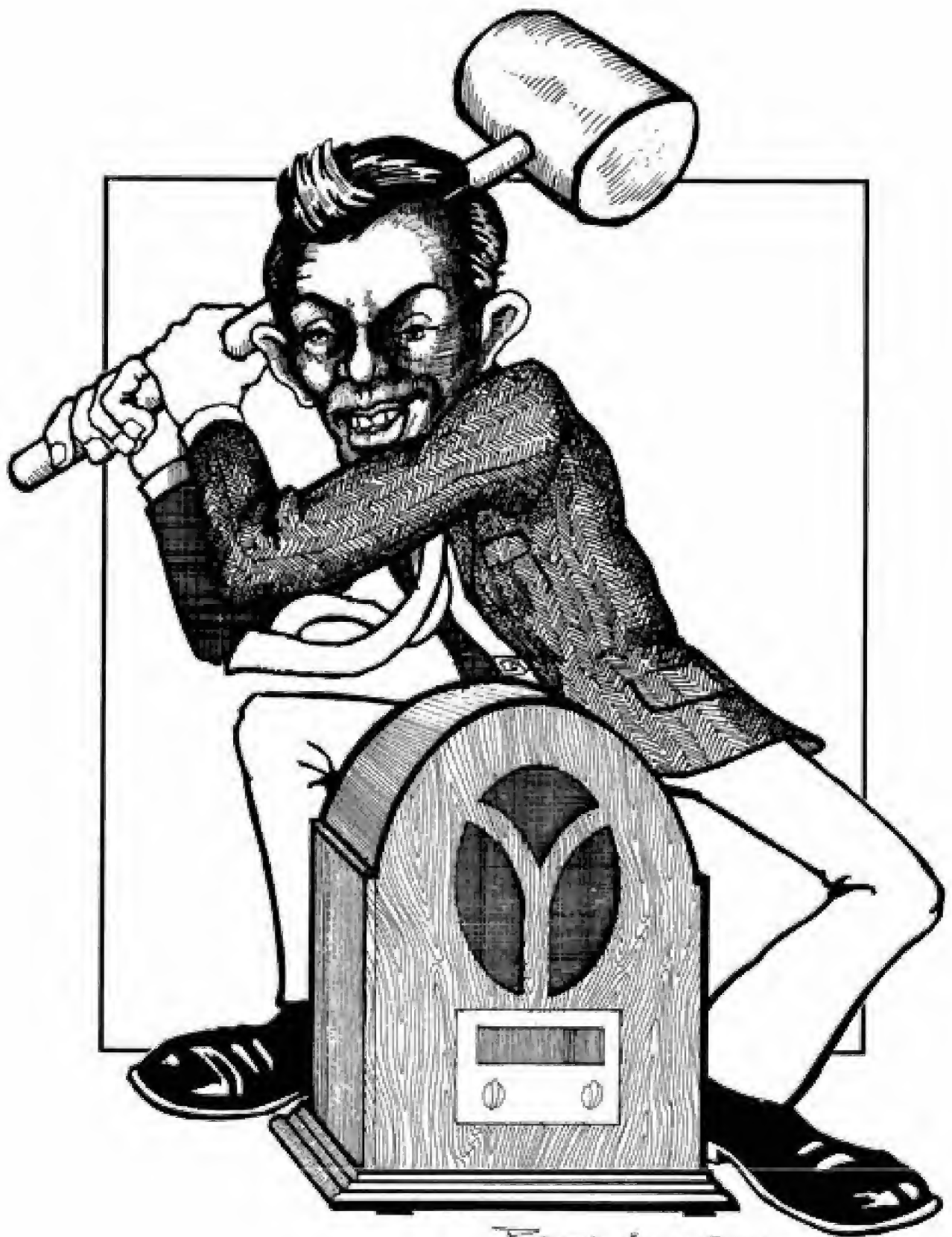
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Robt McCortick

Notes On RFI

By Martin Goodman, M.D.

The Color Computer arrives from Tandy with only one way of putting its video signal on a screen television set. This is known as an RF (radio frequency) interface. This has certain advantages, as most folks own color tv sets. Unfortunately, this link to the screen has several problems.

By virtue of the fact the link is via a radio signal it is vulnerable to RFI (Radio Frequency Interference). RFI commonly appears as moving wavy lines on the screen. Such lines often look like rapidly changing moiré patterns. A second problem arises from using a color image. Color video information of the sort that the CoCo uses is intrinsically "mushy" and blurry. Thus, if one is trying to use a hi-res text screen (51 or greater characters per line) the image is often marginally readable at best.

The first problem (that of RFI) is solved by using a color monitor rather than a TV to display the CoCo's signal. As the CoCo itself is not set up for monitors, a hardware adapter must be installed. Tandy Corp. does not provide such an adaptor. (It does make an "educational" CoCo without the TV coupler but with a color composite video output.) There are many third-party suppliers that supply adapters for existing CoCos. If you own a new model (CoCo 2) and wish to display a color image on a color monitor, Computerware and Mark Data products both supply devices that will do the job. Mark Data's product offers the option of producing a monochrome signal as well. If you own an older CoCo, Moreton Bay Software has a product that provides both a color and monochrome signal from it. Such devices cost between \$25 and \$40. Color monitors cost between \$200 and \$300. For use with the CoCo, virtually all brands of color monitor are equally suitable. Base your choice on price, styling, and (if you can arrange to see it) how the CoCo's signal looks on the screen.

Pay absolutely no attention whatsoever to electronic specifications such as bandwidth in megahertz and horizontal dots resolution. Such nonsense is utterly irrelevant to your choice. Be sure to specify a "color composite monitor," *not* an RGB type monitor.

In all cases you'll need to feed a separate audio signal into a separate audio input on your monitor. All video adapters

mentioned above provide such a signal. While using a color composite video monitor will eliminate all RFI, you will probably be as plagued as ever by hi-res text screens looking blurry. To solve this problem you need to get a monochrome signal and feed it to a monochrome monitor. Computerware, Mark Data Products and Moreton Bay all supply devices capable of producing a monochrome signal from a Color Computer. I personally designed the product from Moreton Bay and tests have indicated that it provides the cleanest monochrome signal of all such devices. It is probably the most-used brand by those on the Color SIG.

Monochrome monitors cost between \$75 and \$150. They come in green, amber, and black and white screen varieties. Green is said to be most likely to produce eye strain. Amber or black and white are felt to be superior for prolonged viewing. A 12-inch diagonal monitor is the typical size used for a personal system. Once again, technical specs are irrelevant.

When you put up a CoCo monochrome signal on a monochrome monitor, text will be extraordinarily crisp and sharp, even in 85-column mode. I personally feel that it is impossible to use the CoCo for word processing without a monochrome monitor. Unfortunately, there is no way to improve on the tendency of adjacent colors to blur into one another using a color video monitor. This is intrinsic in the color composite video process. RGB video would solve this, but no RGB video adapters are or ever will be commercially made for the CoCo. Indeed, I know of only one person who ever made a proper RGB video adapter for the CoCo, and it was very complex.

The system I recommend for most is a monochrome monitor for use with text, relying on the RF signal for use with color. This is cost effective.

Most monochrome drivers for the Color Computer will let you use the existing RF signal. Computerware's driver for the old CoCo ("Video Plus") is, however, an exception. It completely destroys the RF signal when you install it. Moreton Bay's (my) driver for the old CoCo occasionally causes this problem too, but on that driver it can be easily fixed by disconnecting a single wire. (*end*)



on
sig =

Some of our readers are familiar with CompuServe; others aren't. The following "discussion" took place on the CompuServe Color Sig, a section set aside specially for Color Computer users. For those of you who have never used CompuServe, you should be aware that sometimes the discussion takes place in very close to real-time (allowing for typing and sending messages), and other times a longer break of hours or days or even weeks is involved. This discussion took place over about a month, and will be presented in *Under Color* in several parts. Our thanks to the authors, who all gave permission for its use in *UC*.

Fm: ARTHUR DOYLE

The great system tug of war still seems to be on, and no generic winner seems to have emerged. Since I am definitely not an expert in the intricacies of system selection, perhaps my perceptions may be of use when you professionals attempt to crack public apathy.

I bought my first CoCo for my son as a video game. Programs followed . . . arcade games, educational (?) aids, music, then a gamble on a word-processor. The thing worked! My CoCo and Epson soon followed. The typewriter

grew into a terminal with the ColorCom E ROM. System cost at this time? Under \$800. CP/M, Wordstar and terminal programs were selling for over \$1500. Boy, was I smug! Frank Hogg started his revivals at this time, promising that great things were in store for the CoCo. You mean Visicalc! I bought high speed disks. Hardware costs grew to \$1250. Another \$600 was spent to yield \$300 in usable software. Still another \$200 went to training time on Dialog, Dow Jones, CompuServe and Startext. In all, I estimate \$2000 in computer expenditures over the last three years (exclu-

sive of on-line time traceable to specific projects). I have a chain saw and believe that it has paid for itself; I still don't have a decent database.

With software, I estimate an MS-DOS system of comparable capabilities at \$3500. Incidentals and unneeded play-pretties would add another \$1500 for a total of \$5000 of "chain saw" solution. Wait a minute, what was my problem? Oh yeah . . . I need a computer to save money. Any of you mortals out there have need of a \$5000 solution?

I'm trying to expose the real need for a cost-effective tool. The Radio Shack/

Motorola video game is the first of these. Jack Tramiel's Commodore 64 and the Intel PC chip set are others. The other personal computers on the market such as the Apple, IBM and other business machines are just too expensive as a replacement for a typewriter—especially in the home. By purchasing a CoCo or a 64 one can get a generic machine today instead of waiting another four years for IBM to allow Intel to sell their \$500 PC. Instead of Visicalc you'll buy Dynacalc, instead of Wordstar you get Telewriter, and instead of Transend you get ColorCom E. The competition's offerings may be slightly better, but you get to purchase yours at a mature market price.

Into this market is flung a new Super-CoCo. It will probably offer all the enhancements the aftermarket makes available for the Plain-Jane CoCo. Only in this case, it's in one easy-to-use piece—like a Model 4. Well, the middle boy is getting old enough to handle a videogame that can grow into a typewriter—why don't I splurge? Buy the \$1000 contraption for myself and give him the \$200 game. My system cost will then come to \$2800—still within the realm of possibilities of cost recovery (rationalization). *What do you mean I can't run my old software or use my old files!*

Slowly the great CoCo camps split apart. Some software providers stay with the game. Others go with the Business machine. Alas, all the new business software is appearing exclusively for the Super CoCo. Unfortunately, the thinness of the market forces the offerings to be priced accordingly. System costs slowly creep up to IBM levels, whereupon customers desert for the safety of blue. Meanwhile, back at the primeval swamp, where the original CoCo still lurks, it is seen as slowly succumbing to a sickly diet of arcade games—seen as a computer with no redeeming social value. As Super CoCo loses at the upper ends of the market, IBM swoops into the low end of the market with its Intel chip set. Their product is designed to be slower and clunkier than their pricy offerings—but it will run PC software! Programmers desiring to eat flock to IBM. Their chances of selling their wares increase as IBM broadens their base to address even the flint-hearted skeptics (such as myself). By spreading their development costs over a large user base, IBM programmers are able to reduce prices and expand their markets even further. They, like IBM, will seek to become the least-cost producer of a generic product in a mature market. After their competition has been crushed, they will be free to set prices in an ogopolistic fashion at a level just low enough to discourage competition.

I would be interested in the unit volume shipped by the various computer companies. Wouldn't it be shocking if the unit market share of the CoCo or the Commodore exceeded the pc clones by a factor of ten? I would then like to sit down and figure the disposable income available for software/doodad purchases for each of the two groups. Wouldn't it be hilarious if the CoCo/Commodore group was the more profitable market, and that realizing this, IBM introduced a sub-PCjr for this market's exploitation?

How can one believe that a company with Tandy's resources would be unable to design an advanced machine that was compatible with its lower brethren? It's not a technical decision.

I still have hope. Perhaps the new machine will run CoCo, and OS-9, and CP/M, and MS-DOS. That would be a machine to own.

(This message sparked the following six replies:)

Fm: Van (to A. Doyle)

I'd be willing to bet that the average CoCo owner has *more*, and more varied, software than the PC owner, if not because of quality, then at least price!

Fm: Wayne Day (to A. Doyle)

Arthur, you raise some good points . . . lemme see if I can respond to a couple of them.

It is highly likely that the Color Computer is the largest selling computer that Tandy has ever sold. Unfortunately, their demographics say that most purchasers are probably not interested in dBase II or APL or whatever.

It's obvious from Tandy's marketing efforts that they are selling the computer to America (and all over the world) as a "home computer" that can also have fun. In the case of the new 09 (or whatever) machine, understand that *everyone*, except for folks who work for Tandy's designers and executives, are *guessing* as to what the future will bring. It's entirely possible that the new machine will be compatible with Tandy's older software.

But, in the case of a lot of CoCo software from third parties, I'll guess that quite a bit won't be compatible, just as a lot of software became incompatible with the new 1.2 Basic and 1.1 Disk ROMs. Programmer's take short-cuts and/or are lazy, and the user gets the short end.

I feel there is room in this world for a lot of different machines, operating systems, and that, today, there is no machine that is all things to all people.

Buying a car and expecting to buy new parts for it 20 years down the road is expecting the unrealistic.

Buying a computer (any computer) and expecting compatibility in perpetuity is also unrealistic, due to changes in the state of the art.

Again, I go back to what I said before . . . first, decide what you want to do with a computer, then find the software that will do it, and then and only then, go out and buy the hardware.

If your needs change, and you're using the computer in business, you can write it off as a normal cost of doing business. That's what those deductions are on the income tax statement for.

If your needs change, and you're in this as a hobby, you have a couple of options:

- a. change systems to one better suited to your needs
- b. keep the old system and write software that does what you need
- c. keep the old system and accept its limitations.

(This message had one reply, marked by a ★.)

Fm: Dennis Bathory Kitz (To A. Doyle)

Interesting argument, but it doesn't address the non-pop market too well. Do you suppose it's the general public that has snapped up nearly a million CoCos in four years? Look in schools, laboratories, industries and other applications where compact, cost-effective control systems are imperative. I am doing a custom project now for a company buying CoCos in 100 lots for industrial control. Maybe that's only 20–25 percent of the market, but that's a lotta CoCos.

(This message has three replies, marked by ☆.)

Fm: Dennis Bathory Kitz (to A. Doyle)

I ain't no professional, that's sure, and those kind of economic arguments make me resort to church bulletins for intellectual stimulation. Lissen, if you lost track of your goal \$3000 worth, then I fail to understand why I should believe you now. Eh?

Fm: Marty (to A. Doyle)

My info on the "09" is that apart from simple Basic programs and those assembly language programs that use their own DOS or use only documented ROM calls (and most not useful third-party utilities and applications fit that description), the new 09 will *not* have access to the CoCo software base. In

any case, you make a number of very good points, and time will tell what will actually happen.

(This message had one reply, published next installment, and marked by ★★.)

Fm: Sandy Trevor (to A. Doyle)

Reportedly, Tandy is going to great pains to make the System 9 "software compatible" with the CoCo. I guess we'll see what that means after Marty gets one.

(This replay had one response, to be published next month, marked ☆.)

★ **Fm: Marty** (to W. Day)

I beg to differ with you in one point you just made. You implied that "lazy programmers" in the third-party market were to blame for software incompatibilities related to ROM changes. And that this laziness was also responsible for the probable incompatibility of third-party stuff with the coming 09 machine.

You're completely off base there, Wayne.

While it is true that there were some

cases of laziness of that sort by third party types (Telewriter in its early releases was such an example), the main cause of most assembly language application program software incompatibility (and the reason most CoCo third party stuff will probably not be usable under the new Tandy 6809 system) is *not* laziness on the part of third-party programmers, but the inexcusable stupidity on the part of Microsoft in not providing file-handling vectors—documented vectors—for their R/S DOS system, and the equally inexcusable stupidity of Tandy in accepting such an abortion of an "operating system" from Microsoft.

More than anything else, this one so-called oversight has scared off programmers from writing serious stuff for the CoCo.

You are to be condemned for blaming the third-party market in general for the minor mistakes of a few of its programmers, and for excusing the monumental mistake made by Microsoft and Tandy!

Hrumph!

(This has one reply, to be published next month, marked by ☆☆.)

☆ **Fm: Art Gavasso** (to D. Kitz)

Just thought I'd throw my two cents in. If there was not a market for all the CoCos, then who is buying them all? Also, I can buy software for my "game" machine that is as good or better than the PC's at ¼ the price. I wouldn't trade my CoCo and disk drive and printer for a PC for anything. And my cost was \$800 complete with DSDD drive . . . hope that helps the fire glow a bit . . .

★ **Fm: Marty** (to D. Kitz)

Note carefully, Dennis, how in my fanciful design of a dream CoCo ("Dream" article I posted in XA7), I carefully suggested that a minimal machine in a professional box be available for just that market: the industrial and scientific and medical lab and control market . . . a cost-effective, smart, dedicated device.

★ **Fm: Arthur Doyle** (to D. Kitz)

Maybe I wasn't crazy after all. It does seem to work better than some other machines I've tried. Why doesn't someone repackage it with a few more features? (end)

Hints, Tips, and Tricks

General—If you're having RF problems with your Color Computer, you can eliminate them if your TV has a 75-ohm jack (for direct cable input). Buy a phone-jack to F-connector adapter (Radio Shack 278-255) and plug the computer directly to your TV, bypassing the TV connector box you normally use.

Programming—To load two Basic programs into memory without erasing one, try this: Renumber the programs so that they don't overlap one another (the beginning of one doesn't start before the end of the other); CLOAD the lower number program; type POKE 25,PEEK(27);POKE 26,PEEK(28)-2; CLOAD the second program; with Color Basic type POKE 25,6, with Extended Color Basic type POKE 25,30; type POKE 26,1. Now CSAVE the new, combined program.

Programming—When debugging programs, put in a Stop command before the line giving the problem. To facilitate your efforts, print the variables in question before Stopping the program. It'll save time and typing.

Programming—Here's an easy way to verify tape saved programs without losing the copy in memory: rewind the tape and type SKIPF. It'll read over your file and report any errors without erasing the file in memory. If there is a problem, you still have a copy in memory for a second save.

Programming—To load an assembly language tape or disk to a different location in memory by putting an "offset" value after the file name; i.e., CLOAD "file",offset. To move upwards in memory, the offset is calculated by subtracting the old start address from the new one. To move down, subtract the old address from the new one, and add 65536.

ROMpak—To change the untimed stop bit in Color disk Scripsit and change the printer baud, try this: Load DOS (don't run it), list Lines 101 and 102 and make sure the revision number and date are 1.2 and 12/07/81. Now type in:

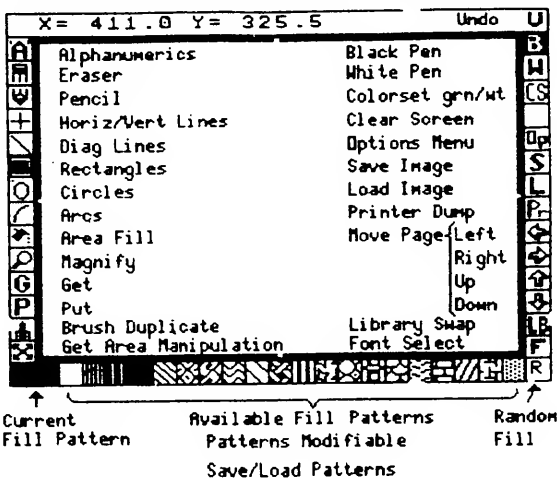
```
15 POKE 3772,&HBD:POKE 3773,6:POKE 3774,&H12:REM fixes stop bit
16 POKE 3783,&H8E:POKE 3784,0:POKE 3785,x:REM x is the baud
```

Line 15 forces Scripsit to use the same timing routine for all bits, and Line 16 substitutes the built-in baud with your preferred rate. Save DOS to disk and the changes become permanent (actually, rename the DOS on disk to DOSBACK before saving the modified version, that way you have the old version, should you need it).

OS9—If you're having problems with Basic9 on your OS9 system, try this on a two drive system: type DEL DIR DEFS, then COPY/D1/BASIC09DO/CMDS/BASIC09. Do this on all your Basic programs (replacing Basic09 with the appropriate name, of course).

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THIS ISSUE'S NEWS IS COCO MAX -- THE FOLLOWING "FIRST LOOK" REVIEW IS BY MARK RANDALL

* * * * * COCO MAX by Tim Jenison / Colorware \$69.95 / 64K Disk or Tape * * * * *

(Note: This review was written February 2, and is based on a pre-release version of CoCo Max; by the time you read this Colorware should be shipping CoCo Max to the public).

It has long been one of my fantasies to own a Macintosh and be able to Macpaint any time I wanted to. Tim Jenison and the folks at Colorware have made that dream a reality. The first time I typed the words RUN"COCOMAX" my reaction was awe and astonishment.

The first thing that impressed me about CoCo Max was its blistering speed. We are talking fast -- REAL FAST -- as if there was a 68000 processor in that CoCo Max cartridge. If you use Color Computer graphics, you too will be impressed with speed of the "rubber band line" and "rubber band shape" drawing routines. Besides being an amazing programming accomplishment, its speed makes CoCo Max a pleasure to work with.

CoCo Max is a clone of Macpaint from Apple's Macintosh computer. I didn't really think that there would ever be a clone on the CoCo that would be true to the original Macpaint, yet CoCo Max supports all of the major features of Macpaint with few exceptions (most notably the ability to stretch and shrink "captured" portions of the screen along a few of the more obscure Macpaint "shortcuts"). In fairness to the program's author Tim Jenison (designer of the Micro Works Digisector Video Digitizer) I should mention that these were left out simply because he ran out of memory. Keep in mind that it takes 128K to run Macpaint on a Macintosh, yet Tim was able to shoehorn almost all its features into a 64K CoCo. In fact, the program is so similar to Macpaint that I learned how to use it from a borrowed Macpaint manual!

Macpaint's features separate the Mac from other drawing tools. On any page of Macworld magazine, the chances are pretty good that you will see the phrase "User Interface". That's what set the Mac apart from all other computers, until now. The Macintosh's friendly user interface asks the user to point with a mouse to a picture of the desired activity -- pictures known as "icons". Once you are pointing to the desired icon, you press the mouse's button to select it; thus, the phrase "point and click". Macpaint drawing tools are on the left side of the screen. When you "click" on the desired tool it is highlighted in black. In the accompanying pictures, the "hand" icon (second from the top) is selected. If you "point and click" on one of the words along the top of the screen you will get a "pull-down menu". You may select any option on the menu by clicking on it while the menu is pulled down (see picture #2). This user interface allows the "non-techie" to use the advanced features of a microcomputer without having to understand how they work. My mother (a professed computerphobe) will sit down to use CoCo Max any time; young children also find it very easy to understand and use.

Yes, there is some bad news. The biggest problem is that it may end up costing you more than \$69.95 to use CoCo Max fully. If you are a disk owner (the tape version won't be ready until March) you will need a Y-cable or multi-pak to use CoCo Max's 8-bit analog-to-digital converter cartridge. Second, while you can use CoCo Max with a joystick, I recommend that you use a mouse, since it is more Mac-like and you have better control. Last, the program looks best on a monochrome monitor, largely because the original Macpaint is exclusively a black-and-white system. Tim has made some changes to the program to ease the use of the CoCo's high res colors, but even so I would at least recommend a color monitor or high quality television. Of course you can use CoCo Max without investing additional money, but to be honest, since getting CoCo Max I have bought a multi-pak, mouse, monochrome monitor and driver and I don't regret a penny of it! It's still a lot cheaper than \$1500 for a Macintosh.

I asked Jack Knott, President of Colorware, a few questions after seeing the CoCo Max ads, and added some of my own:

Q. What printers does CoCo Max support?

A. Although all the printer drivers are not in the pre-release version, Colorware states that the Epson/Gemini, all Tandy dot matrix, and C. Itoh Prowriter printers will be supported. You will be able to print out in small and large and double strike and normal modes.

Q. Part of the screen is taken up tools and menus; how large is my actual work area?

A. CoCo Max uses windowing to allow your effective workspace to be larger than what can be displayed on the screen at one time. The total amount of workspace is roughly 3 1/2 times that of one window. You can select the hand icon and use it to move your workspace like a piece of paper. You will also be able to print your entire workspace as one big picture on a single piece of paper.

Q. What does that cartridge that comes with CoCo Max do?

A. It is an 8 bit analog-to-digital converter that the mouse or joystick plugs into so you can make large free hand strokes from one end of the screen to the other without jumping or being jerky.

Q. How many type fonts does CoCo Max have?

A. At least five; you can italicize, boldface, outline, and drop-shadow any font.

Q. Will I be able to draw graphics like those shown here?

A. The Garfield is by a friend who is not an artist but can draw a straight line. The Mr. Chips picture is by Mr. Thumbs, yours truly. The Fat Bits mode allows you to zoom in on working areas, and helps make a no-talent like me look pretty good.

Q. Can I paint with patterns other than those at the bottom of the screen?

A. Yes, there is another palette like the one you see, but geared more towards the artifact color set. You may also edit the existing patterns to create a new one.

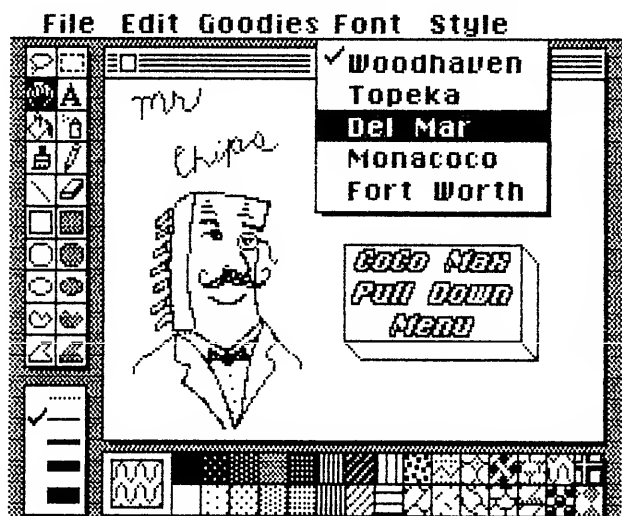
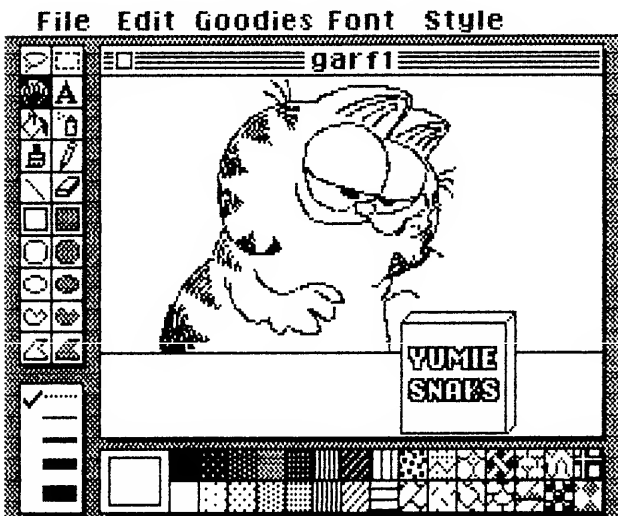
Q. Are CoCo Max disk files compatible with BASIC?

A. Yes, CoCo Max pictures are binary files that start at \$E00 so you can use them with BASIC programs or even other drawing programs.

Q. Can I have some of those neat pictures to look at?

A. If you have a modem you may download these and several other pictures from the Color America Users Group BBS in Los Angeles at (818) 335-6554.

It is a reviewers duty to help you to decide whether you want to buy a product; I have the perfect way for you. Go to your local computer store, sit down and play with Macpaint, and if you like what you see ... save yourself \$1500 and get CoCo Max! There have been few CoCo programs that revolutionize the use of our computers. For me CoCo Max is one of those programs. It is one of the top three CoCo programs ever written.



Jarb Electronics
\$120

Mark Data Products
Super Pro
\$65

HJL
\$85

Micronix
\$85

Keytronics
\$85

Since its introduction, the Color Computer has been supplied by Tandy with three different keyboards. For the first two or three years Tandy's gray-cased units came with a "chicklets" keyboard. They then switched to cream-, and then white-cased units, and began supplying full-sized keys on the keyboard. These keys looked "squashed" however . . . they did not rise much above the level of the keyboard background. More recently Tandy has begun to ship Color 2's with full-sized keyboards with textured and sculpted keys.

The first two keyboards (chicklets and the first improvement to full-sized keys) were quite useable for occasional programming but distinctly inferior for word processing. The keyboard currently supplied by Tandy is not that bad for typing, though the key travel on it is to my taste unpleasantly short. All three keyboards, however, appear to be rather similarly (cheaply) made. The first two clearly demonstrated a tendency to wear out quickly with heavy use. I suspect that the current model will also not prove very durable.

If you own one of the older keyboards you'll certainly want to consider buying a third party replacement for it. Even if you own a new one you might want to replace it if you don't like the short keystroke travel it offers. What options do you have?

Hardware Hacker Options: The extremely poor quality of the original "chicklets" keyboard provided a fertile area for third party support. For the hacker, Dennis Kitz (in an article in January, 1982, '80 *Micro*) described how to modify an old Model I keyboard and install it in the Color Computer. He observed that as those keyboards were being pulled from service they could be had for \$10 to \$15 from cooperative Tandy computer repair people. Currently, the old Model III keyboards are being pulled from Mid III's that are being upgraded to Model 4 status. I've bought about half a dozen of these for \$5 to \$10 each. These are excellent keyboards and their existing wiring is nearly the same as that of the Color's keyboard. Only a few trace cuts and jumpers need be added. To help you install these keyboards get a schematic for the Color keyboard and for the Mod I or III. You'll find that only four keys of one row are in a different place. Just trace this row out on your board and make appropriate changes. I do *not* recommend wiring a non-Tandy keyboard up from scratch. I've done this myself, once, and it is an outrageous waste of time! If you want to "do it yourself" start with a Mod I or III keyboard.

If you're going to be hacking let me make a suggestion—connect it with a 15-conductor cable! I have a Mod II type keyboard mounted in an old Mod I shell connected via a piece of 20-conductor shielded ribbon cable. I've wired up a Reset button and a power-on light on the keyboard as well. As I type this article I'm reclining in my easy chair with the keyboard on my lap. I make one mistake in the design of my lap keyboard: forgot to make it with a "palm rest." That is, I neglected to find or build

a case for it that had a minimum of three inches of space below the space bar. I'm correcting this flaw in the second remote keyboard I'm building now. One other note: the early CoCo's had a pin connector for the keyboard. The current ones have an edge card/ribbon connector. Male connectors to the new kind of keyboard are hard to come by. You may decide to desolder the keyboard connector and install your own connector. I like to use DB15 or DB25 type connectors as they are highly available and highly reliable.

Commercial Options: The first commercial replacement keyboard on the market was to my knowledge a \$120 remote keyboard from Jarb in San Diego. This was a very nice unit, though I'm not sure if it's still available.

Mark Data then introduced the "Super Pro" keyboard. This is currently the least expensive, available for \$65 plus shipping and handling from Mark Data Products. It has become one of the very most popular keyboards. The mechanism is identical to the old Model I (Hi Tec brand) keyboards. Later on HJL introduced its keyboard, which features membrane switches (very durable) and sells for around \$85. Micronix entered the market first with its "professional" keyboard (a piece of trash with weirdly positioned keys and too strong springs) and then a new keyboard (a very nice ALPs type keyboard that is almost identical in touch and feel to that of the Model III). Finally, Keytronics has a keyboard on the market, too. Both the Keytronic product and the Micronix product sell for around \$85.

Deciding which keyboard to use is a very subjective affair. Some keyboards that I like others hate, and vice versa. My bias is toward medium key travel and medium mushiness and a textured feel. I tend to like the Model III keyboard very much, though it's a little too mushy to be perfect.

If you like the old Model I keyboards you'll like the Super Pro; a keyboard that is identical to the Model III keyboard is the Micronix premium. It's a very fine unit. The HJL keyboard has, to my taste, the most pleasing textured feel. I've used one extensively and like it very much. It's quite crisp in its feel, with a reasonable length of key travel. I'm biased against the Keytronic's unit; for my taste it has much too short a key travel distance. But if you like the keyboard on the current Tandy Color machines you'll like the Keytronics. Both have very short key travel. The Keytronics resembles a number of IBM pc keyboard copies.

Because all of the above products are much more likely to withstand prolonged use (the HJL is probably the most durable of the lot) they are to be preferred to even the current Tandy keyboards. One final note: these keyboards offer two or four extra "function" keys. This relates to the fact that in its design of the CoCo, Tandy left out four possible switch positions on the matrix it used. Now if Tandy had, from the start, used those four positions, it might have been nice (I'd have liked a designated control

key). However, since they weren't used, virtually no available software supports such added function keys. If you happen to buy a keyboard with those extra keys I recommend you ignore them entirely.

I broke off the four function keys on my HJL keyboard when I found myself hitting them accidentally instead of the shift keys. (end)

Multipak
Radio Shack
 Fort Worth, TX
 \$160

CoCo Bus
PBJ
 POB 813
 N. Bergen, NJ 07042
 \$150 assembled \$23 bare board

Over the last two years a number of expansion system ports have been introduced for the Color Computer. Only two have seen relatively widespread use by myself, my friends, and the circle of hackers who congregate on the Color Computer Special Interest Group: Multipak and the PBJ "C-C Bus." There have been other products but those products have either been withdrawn from the market or are in very limited use due to their limited capabilities, high prices, or both.

The Tandy Multipak sells for \$160 list although it has been discounted by Tandy to \$79 and \$99 on several occasions. The PBJ C-C Bus sells for \$150 assembled and tested but is also available as a bare board with full documentation for \$23. The Tandy product offers four extra system slots; the PBJ product offers six slots. The Tandy product offers control of slot selection via hardware (an external switch) and software (POKEs to a given port in the \$FFXX region). The PBJ product selects its slots via software only. The Tandy product comes in a more or less attractive white plastic case with a built-in power supply. The PBJ product looks rather more stark and has an external power supply (a wall transformer type unit). The Tandy product provides mechanical support (via its case) for its vertically mounted plug-in cards. The PBJ product provides *no* mechanical support for the card you plug in to it . . . they just sit there, held in by the force of the 40-conductor edge connector socket. The Tandy product provides full and proper grounding from the ground tabs of the CoCo to ground clips supplied on the Multipak. The PBJ C-C bus provides no connection between the CoCo's ground tabs and any ground tabs that might be on cards you plug in.

Regarding the lack of proper grounding on the PBJ product: observant and sophisticated PBJ C-C bus owners use the product, and *none* have reported any difficulties with the C-C bus that might relate to bad grounding. Specifically, I'd fear that disk I/O might be subject to infrequent failures. But no PBJ bus owners have reported this to me. Al of PBJ (a very conscientious fellow) also informs me that no one has ever complained to him about such problems. I still don't like the lack of ground tabs on his product, but must make it clear that all current empirical evidence indicates that the "oversight" has not affected the reliability of the product at all. (Those who own PBJ C-C buses who want to add such ground clips should try making them out of bent fuse clip holders.)

There has been one complaint on the Sig that the power supply for the PBJ C-C bus is a bit too weak to handle five cards plugged in simultaneously, though it seems that one of those five cards was unusually power hungry in the first place. From what I've heard, I suspect that the Tandy Multipak would not have had enough juice either.

Going to a more technical level, there are two or three other comparisons between these two items that are important. The Tandy Multipak offers (under software control) switching among its four slots of both the CTS ("ROM select line") and the SCS (port select line) *independently*. The C-C Bus offers only *combined* switching of the CTS and SCS line together. With some sophisticated hardware cards (such as video digitizers and EPROM programmer cards) this may result in the PBJ C-C bus having problems. In most cases, this deficiency will not be noticed. The Tandy Multipak has a tinned male connector to the CoCo.

Both buses have gold-plated edge-card female connectors for the plug-in boards. The NMI and HALT lines are not buffered on the Tandy Multipak. This oversight results in the SAM and CPU being at high risk of being destroyed if you accidentally plug in or remove a card in the Multipak while the power is on. The PBJ C-C bus does buffer the NMI line, resulting in an added degree of protection to the CoCo itself. The Tandy Multipak uses a PAL (program array logic) chip to do a lot of its address decoding. Unfortunately, the programming of that PAL chip is not published by Tandy in its service manual for that product. The PAL is not hard to read . . . Tandy did not blow the verification links. Most folks, however, do not have PAL readers handy. The upshot of all this is that there were some addressing idiosyncrasies that were not apparent from the Multipak's documentation that caused serious problems for some hardware designers. The PAL refuses to allow writing to memory in the address space between \$8000-\$FEFF even if you've decoded your own chip select line directly from the address bus.

The PBJ C-C Bus uses small scale logic only to do its address decoding, and so holds no nasty surprises for hardware designers using it. The designer of the PBJ board (Aiberto of PBJ) is available for consultation with his customers.

In both the Multipak and the PBJ C-C bus, assembled and tested versions, the chips are all soldered (with the exception of the PAL chip in the Tandy product). But you can order the C-C bus as

a bare board and so have the option of socketing its chips.

Recommendations: The two units have different strong points and different weaknesses. In many cases the weaknesses of either may be corrected by a minimum of hardware tinkering. To the hardware switching among the cards plugged into the number of slots and more straightforward address decoding would make it much more attractive, as does its availability as a bare board with instructions. To the casual purchaser, I might recommend

the Tandy Multipak. Being Tandy, it's going to be something of a standard. And if you buy it on sale it is more attractively priced than the assembled and tested C-C bus unit. Although PBJ is extremely swift in supporting repairs for many folks, it's just much more convenient to take a blown item back to a Radio Shack dealer. Finally, the availability of external hardware switching among the cards plugged in to the Tandy Multipak will make it more attractive for those who want to use it to switch among ROM packs. (end)

TRS-80 Models I, III, & Color Computer Interfacing Projects by William Barden, Jr.

**Howard W. Sams & Co., Inc.
4300 West 62nd St.
Indianapolis, Indiana 46268
\$14.95 paperback**

One of the opening sentences in this book says it best: "the Color Computer has an amazing amount of circuitry built into it for the price." That has been the secret of the Color Computer's success: a versatile, yet inexpensive, machine that has something for everyone.

TRS-80 Models I, III, & Color Computer Interfacing Projects by William Barden, Jr. is directed towards the person who would like to learn about hardware and interfacing aspects and explore the way software and hardware work together to make a computer and its peripherals communicate with each other. Much of the book exploits the interfaces already present in Radio Shack computers. The joystick input are actually low-resolution analog-to-digital converters so the single most vital function needed for data acquisition is already built-in. Likewise, the serial ports that drive the printer and cassette recorder are fine for single-bit input/output. Mr. Barden provides a virtual feast of projects using these built-in interfaces, for everything from temperature and light-intensity measurements to voice storage and playback, from telephone dialing to windspeed measurement. The entire book was essentially published as a year-long series in *BYTE* (December, 1981–November, 1982); readers with access to those back issues can enjoy this material and save the price of the book.

The latter chapters cover more general interfacing through the expansion connectors. Barden constructs general-purpose I/O boards for the expansion ports of the three computers, and gives simple applications, such as switch-closure detection, relay driving, and analog/digital or digital/analog converter interfacing. The book concludes with a useful discussion of signal conditioning and transducers for sensing outside-world signals.

Mr. Barden is well-known for his readable and practical tutorials, and this book is no disappointment. Every effort has been made to accommodate the novice, but Barden manages to do it in a way that shouldn't bore even a moderately advanced reader. His projects include complete parts lists and wiring-point tables to help people who are uncomfortable with schematic diagrams. The book covers such a variety of different applications that it's hard to imagine anyone not finding something of interest

here. There's a good balance of coverage and projects for each of the three computers. Color Computer enthusiasts need not beware the inclusion of other machines in this book; there's plenty here for users of any of the machines to get their money's worth.

I had only a couple of minor complaints, both directed at Chapters 16 and 17, which deal with use of the Color Computer expansion connector and a general-purpose I/O board for it. This material was prepared before Radio Shack's introduction of the latest revision of the full-size circuit board (the so-called F board), and before the introduction of the Color Computer 2. Barden uses the CTS signal, which is the \$C000 select at pin 32 of the expansion connector, to address his I/O device. That's fine for Revision E circuit boards and earlier, but the F board, the CoCo 2, and earlier boards that have been retrofitted for 64K RAM all use gates that disable the CTS line for write operations. Only read operations will generate the \$C000 select on those machines; thus, his CoCo interface project won't work, and his descriptions of how to write to an I/O device plugged into the cartridge port are obsolete for machines produced since October, 1982 or so. The \$FF40 select at pin 36 should be substituted for CTS, as it's active for both input and output on all machines.

Also, Barden uses the 8255 chip, an old I/O device introduced originally as a member of the 8080 microprocessor family. This device does have 24 I/O lines rather than the 16 of newer chips, but the lines are less configurable and the programming for the 9255 is unnecessarily complicated by today's standards. The 8255 is OK for the Models I and III, which use 8080/Z-80 technology, but I would much rather see a 6820 or 6522 for the CoCo expansion. Those chips are designed for the 6800/6809/6502 family of microprocessors, and are more representative of modern hardware.

This is an excellent book for nearly everyone who is interested in learning about interfacing and simple hardware construction. With the warning in mind about using the I/O board with newer CoCos, the projects are useful and should serve well to introduce owners of these computers to the fascinating world of data acquisition and control. (end)

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REVIEWS

By Kalvos Gesamte

PRODUCT

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Church Time

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Quality Christian Software Dept. A, P.O. Box 1899 Duncan, OK 73534

Way back in 1979, when I was sending out a free newsletter for TRS-80 owners, I would often receive original programs in return. One of these was "Bible Verse Hangman" by Stan Ockers, a midwestern KIM-1 specialist, and the other, by up-and-coming programmer Joe Teller, was "Shipwreck." The Bible verse game was a hit around the house, since not only did you have to guess the Bible verse as you filled in the blanks, but you could guess chapter and verse as well. Nobody ever got "hanged," just gently admonished. "Shipwreck" was a satisfying but fairly typical adventure game of the sea-and-sand variety. Neighborhood youngsters loved it; there was none of the typical adventure violence, just survival dependent on wits and skill.

Half a decade later, four of us (one "test" minister, two Christians, and an atheist) gathered 'round the old monitor to have a crack at some new programs from Quality Christian Software: "Pilgrim's Progress," "Church Time," "Christmas Quiz," and the "3-Game Pack." Our mutual feelings about these programs is reflected by one reaction: how good can a commercial program on a religious topic be when its authors hyphenate and spell incorrectly, and misspell the names of books and characters in the Bible?

That's not a minor dissatisfaction; in fact, it disturbed our test minister enough that, although he might have considered using some of the programs as reinforcement pastimes for his religious classes, he scrapped the idea due to the host of minor inaccuracies. Furthermore, in the 3-Game Pack (the best of the quiz-game lot), one question had two correct answers, but only one answer was accepted. In another game, choosing the correct response depended on which translation of the Bible is used.

All the QCS programs loaded on the first try, although Pilgrim's Progress required a pre-run PMODE:PCLEAR1 when used with early computers. During our experience, none of the programs crashed with an error message.

It's difficult not to take an un-Christian attitude toward these Christian programs. Originality and better programming should be expected, but I want to forgive those limitations in the belief that the programmers have placed evangelical mission above details. Somehow I feel sure that all my complaints are devils dancing on the head of a pin. In fact, QCS President Terry Presgrove forbids program copying, although "one exception . . . would be the sharing of QCS software with non-Christian owners for evangelistic purposes." Hard to fault that generosity, I suppose.

"Church Time" and "Pilgrim's Progress" are both adventure games. "Church Time" operates under the quirky premise that you've left for church, forgotten your Bible, gone back to get it, and locked yourself in the house. You have to get out of the house and to church on time (reminds me of a song . . .). "Pilgrim's Progress" is more complex and serious, based on John Bunyan's theological treatise of Christian growth. The objects of the game,

according to the documentation, "is to obtain all Nine Fruits of the Spirit. Your progress is directed away from the city of Destruction and toward the Holy City. Important doctrines are grasped as the player proceeds."

The best adventure game was "Pilgrim's Progress," since it was the most serious, the most thoroughly constructed and had the largest repertoire of responses. John Bunyan's original "Pilgrim's Progress" is not on the best-seller list these days. It would have helped to have a summary of the book, since so much of the game's plan was based on it; in fact, the documentation as a whole was poor for the QCS games. Documentation for "Pilgrim's Progress" is the longest, and is—excluding the message from the QCS president—just over one side of a page.

None of us—not our test minister, our Christians, or our atheist—did well. Perhaps America is a latter day Sodom and Gomorrah, but we always ended up (rather, ended down) in the fiery kingdom. The statement "important doctrines are grasped as the player proceeds" turned out false for us.

Unless you are a hard-core adventure maniac ready to play anything that comes along, or a Christian hungry for any software at all, "Pilgrim's Progress" and especially "Church Time" are only mediocre implementations of the adventure game principle.

The quiz games were more immediate and satisfying. Many of the Bible verses, especially those from the Old Testament, were tricky, and the "Christmas Quiz" questions centered around popular myths that are often unsupported by Biblical reference. No, the actual number of wise men is never stated, only inferred from the three gifts that they bring. All the drills are timed, and the "Who Did That" and "Who Said That" games are decidedly slippery. One of our test Christians had a better handle on Bible references than the minister, yet she often stumbled on questions about Old Testament women, characters of similar name (Elijah and Elisha), and obscure books (Nahum and Titus). After a round or two, though, the initial enjoyment wore thin as the available references ran out and the grammar and spelling problems grew more irritating.

Quality Christian Software claims that these programs teach Christian principles. If I'm to believe the programs themselves, though, "Christian principles" essentially mean aphorisms. There are no monsters to kill in the adventures ("Thou shalt not kill," of course), and clues to getting around are given if you enter PRAY. Temperance is encouraged; if you stop for a donut in "Church Time," you lose—they're jelly donuts, the jelly gets on your clothes, and you're late for church.

These programs from America's Bible Belt don't always carry the same message to those of us Down East. Perhaps we're too hasty or more demanding or less godly. But I mentioned "Bible Verse Hangman" and "Shipwreck" because they hold at least as much interest as the offerings of QCS—and they were written in 1979. Even if you believe QCS is dealing in a limited audience and a specialty topic, more interesting and more thoroughly researched programs should be expected in 1984. (end)

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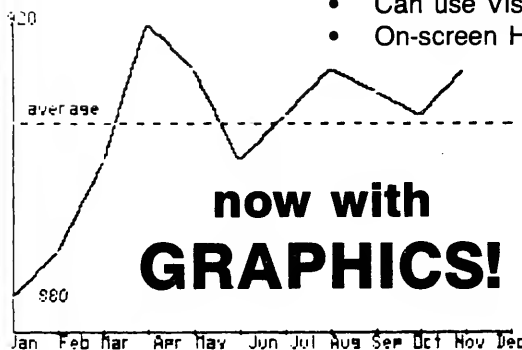
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